

SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT I, TATSUYA FUJII, a  
citizen of Japan residing at Kanagawa, Japan have  
invented certain new and useful improvements in

POWER CONTROL APPARATUS FOR A BATTERY-POWERED  
COMMUNICATION SYSTEM

of which the following is a specification:-

1     BACKGROUND OF THE INVENTION

          (1) Field of the Invention

          The present invention relates to a power  
control apparatus which is suitable for use in a battery-  
5     powered system, such as a cellular mobile telephone or a  
portable electronic device.

          (2) Description of the Related Art

          A power control apparatus provided in a  
battery-powered system, such as a cellular mobile  
10     telephone or a portable electronic device, is known. In  
the power control apparatus, a source voltage of a battery  
is converted into a controlled voltage, and the controlled  
voltage is supplied to each of driven circuits (or  
functional elements) of the system. There is a demand for  
15     the power control apparatus of this type to reduce a power  
consumption of the driven circuits. In recent years, the  
power control apparatus of this type has been improved for  
the purpose of reducing a power consumption of the driven  
circuits.

20           For example, Japanese Laid-Open Patent  
Application No. 5-088790 discloses a power control system  
which is adapted to allow a sleep-mode operation of a CPU  
(central processing unit) in which the operation of the  
CPU is assured and the power of the CPU is turned OFF.

25           Japanese Laid-Open Patent Application No.

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1 5-265597 discloses a micro-controller which allows a  
driven circuit to operate at a low voltage in a selected  
mode. In the micro-controller, a source voltage supplied  
to the driven circuit is controlled so as to meet one of  
5 power consumption reduction, operating speed increase and  
noise reduction modes.

Japanese Laid-Open Patent Application No.

6-139373 discloses a semiconductor device provided with a  
switch selectable between a normal power mode and a power  
10 saving mode. In the semiconductor device, a voltage  
supplied to a driven circuit is controlled by setting the  
switch to select one of the two modes.

FIG. 7 shows a conventional power control  
apparatus. The conventional power control apparatus of  
15 FIG. 7 includes a power-supply circuit 61 which supplies a  
source voltage of a first battery 60a through a diode 80  
to a driven circuit 71. A power-supply circuit 62  
supplies the source voltage of the first battery 60a to  
each of a driven circuit 72 and a power-supply circuit 63.  
20 The power-supply circuit 63 supplies a lower voltage,  
derived from the source voltage of the first battery 60a  
or from the power-supply circuit 62, to a driven circuit  
73. A source voltage of a second battery 60b is supplied  
through a diode 81 to the driven circuit 71.

25 In the conventional power control apparatus

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1 of FIG. 7, the second battery 60b and the diode 81  
constitute a backup power supply that acts to supply the  
source voltage of the second battery 60b to the driven  
circuit 71 when the source voltage of the first battery  
5 60a supplied to the driven circuit 71 by the power-supply  
circuit 61 is discontinued. The power-supply circuit 63  
acts as a dependent circuit that operates in dependence on  
a power-supply operation of the power-supply circuit 62.  
That is, the dependent power-supply circuit 63 operates to  
10 supply the lower voltage to the driven circuit 73 when the  
power-supply circuit 62 is operating. The dependent  
power-supply circuit 63 may include a DC-DC converter or a  
voltage regulator.

The relationship between the power-supply  
15 circuit 62 and the dependent power-supply circuit 63 is  
needed when the conventional power control apparatus  
includes functional blocks indicated by a dotted line in  
FIG. 7. That is, the relationship between the power-  
supply circuit 62 and the dependent power-supply circuit  
20 63 is needed when one of the functional blocks (for  
example, the driven circuit 72) is driven by the power-  
supply circuit 72 at the source voltage of the battery 60a  
while the other functional block (for example, the driven  
circuit 73) is driven by the power-supply circuit 63 at  
25 the lower voltage derived from the source voltage.

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1                   In the conventional power control apparatus  
of FIG. 7, each of the driven circuits 71, 72 and 73 is  
provided with an oscillation circuit. When the  
oscillation circuit generates a clock signal with a  
5   lowered frequency and supplies the clock signal to the  
driven circuit of concern, the driven circuit is set in a  
low-speed mode so that it operates at a low speed. When  
the oscillation circuit stops supplying the clock signal,  
the driven circuit of concern is set in a stand-by mode.  
10 By using the oscillation circuits of the driven circuits  
71, 72 and 73, the conventional power control apparatus of  
FIG. 7 acts to reduce the power consumption of the driven  
circuits 71, 72 and 73.

                  In the conventional power control apparatus  
15 of FIG. 7, if the source voltage is continuously supplied  
to the driven circuit of concern during the stand-by mode,  
it is difficult to completely prevent the flow of a leak  
current from a MOS (metal oxide semiconductor) transistor  
of the driven circuit. In order to eliminate this  
20 problem, it is necessary for the power-supply circuits 61  
and 62 to stop the supplying of the source voltage of the  
first battery 60a to the driven circuits 71 and 72 when  
the driven circuit is in the stand-by mode.

                  However, in the conventional power control  
25 apparatus of FIG. 7, the power-supply circuit 63 continues

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1 to supply the lower voltage to the driven circuit 73  
during the operation of the power-supply circuit 62. Even  
when the operation of the driven circuit 73 is not needed,  
the power-supply circuit 63 continuously supplies the  
5 lower voltage to the driven circuit 73. In such a  
condition, the driven circuit 73 unnecessarily consumes  
the power supplied by the power-supply circuit 63, and the  
conventional power control apparatus of FIG. 7 does not  
act to reduce the power consumption of the driven circuit  
10 73.

#### SUMMARY OF THE INVENTION

An object of the present invention is to  
provide an improved power control apparatus in which the  
15 above-described problems are eliminated.


Another object of the present invention is  
to provide a power control apparatus which is effective in  
reducing a power consumption of a driven circuit by  
suitably controlling a power-supply operation of a  
20 secondary power-supply circuit which supplies power to the  
driven circuit in dependence on a power-supply operation  
of a primary power-supply circuit.

The above-mentioned objects of the present  
invention are achieved by a power control apparatus  
25 including: a first driven circuit; a second driven circuit

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1     which is connected to the first driven circuit; a primary  
power-supply circuit which produces a primary voltage from  
a source voltage of a battery and supplies the primary  
voltage to drive the first driven circuit; a secondary  
5     power-supply circuit which produces a secondary voltage  
from the source voltage of the battery or from the primary  
voltage of the primary power-supply circuit and supplies  
the secondary voltage to drive the second driven circuit;  
and a control circuit which outputs a power-supply control  
10    signal to the secondary power-supply circuit in response  
to a command signal, so that the supply of the secondary  
voltage to the second driven circuit by the secondary  
power-supply circuit is started or terminated by the  
power-supply control signal.

15             The above-mentioned objects of the present  
invention are achieved by a power control apparatus  
including: a first driven circuit; a second driven circuit  
which is connected to the first driven circuit; a primary  
power-supply circuit which is connected to a battery, the  
20    primary power-supply circuit producing a primary voltage  
from a source voltage of the battery and supplying the  
primary voltage to drive the first driven circuit; a  
secondary power-supply circuit which is connected to the  
primary power-supply circuit, the secondary power-supply  
25    circuit producing a secondary voltage from the source



1 voltage of the battery or from the primary voltage of the  
primary power-supply circuit and supplying the secondary  
voltage to drive the second driven circuit; a primary  
oscillation part which outputs a clock signal to the first  
5 driven circuit; a primary reset generating part which  
outputs a primary reset signal to the first driven circuit  
when an oscillation of the primary oscillation part is  
detected to be stable, the primary reset signal causing  
the first driven circuit to start operation in accordance  
10 with the clock signal output by the primary oscillation  
part; a control signal generating part, connected to both  
the first driven circuit and the secondary power-supply  
circuit, which outputs a power-supply control signal to  
the secondary power-supply circuit in response to a  
15 command signal output by the first driven circuit, so that  
the supply of the secondary voltage to the second driven  
circuit by the secondary power-supply circuit is started  
or terminated by the power-supply control signal; a  
secondary oscillation part which outputs a clock signal to  
20 the second driven circuit; and a secondary reset  
generating part which outputs a secondary reset signal to  
the second driven circuit when an oscillation of the  
secondary oscillation part is detected to be stable, the  
secondary reset signal causing the second driven circuit  
25 to start operation in accordance with the clock signal

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1 output by the secondary oscillation part.

The power control apparatus according to the present invention is effective in reducing the power consumption of the second driven circuit in contrast to the conventional power control apparatus. In a preferred embodiment of the power control apparatus of the present invention, the power-supply operation of the secondary power-supply circuit is suitably controlled such that the supply of the secondary voltage to the second driven circuit is enabled by a high-state power-supply control signal only when it is needed, and the supply of the secondary voltage to the second driven circuit is disabled by a low-state power-supply control signal when it is  
10  
unnneeded. In a preferred embodiment of the power control apparatus of the present invention, the oscillation of the secondary oscillation part is quickly stabilized after a start command signal is output to the control signal generating part by the first driven circuit, and it is possible to achieve a speedy power-supply operation of the first and second driven circuits. Further, a preferred embodiment of the power control apparatus of the present invention acts to prevent the flow of a leak current from the first driven circuit into the second driven circuit when the supply of the secondary voltage to the second  
20  
driven circuit is stopped, and it is possible to more  
25

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1 effectively reduce the power consumption of the driven  
circuits.

BRIEF DESCRIPTION OF THE DRAWINGS

5 Other objects, features and advantages of  
the present invention will become more apparent from the  
following detailed description when read in conjunction  
with the accompanying drawings in which:

FIG. 1 is a block diagram of a power  
10 control apparatus embodying the present invention;

FIG. 2 is a circuit diagram of a control  
circuit of the power control apparatus of FIG. 1;

FIG. 3 is a time chart for explaining  
operations of the control circuit of the power control  
15 apparatus of FIG. 2;

FIG. 4 is a time chart for explaining  
power-saved periods during an operation of the power  
control apparatus of FIG. 1;

FIG. 5 is a circuit diagram of a  
20 modification of a secondary oscillation circuit in the  
control circuit of FIG. 2;

FIG. 6A and FIG. 6B are circuit diagrams of  
a modification of first and second driven circuits in the  
power control apparatus of FIG. 1; and

25 FIG. 7 is a block diagram of a conventional

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1 power control apparatus.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

5 A description will now be given of the preferred embodiments of the present invention with reference to the accompanying drawings.

FIG. 1 shows an embodiment of a power control apparatus of the present invention.

10 As shown in FIG. 1, the power control apparatus in the present embodiment includes a power-supply circuit 2 which supplies a source voltage of a battery 10 through a diode 4 to a driven circuit 5. A source voltage of a battery 1 is supplied through a diode 3 to the driven circuit 5. The battery 1 and the diode 3  
15 constitute a backup power supply that acts to supply the source voltage of the battery 1 to the driven circuit 5 when the source voltage of the battery 10 supplied to the driven circuit 5 by the power-supply circuit 2 is discontinued.

20 The elements 1, 2, 3, 4 and 5 of the power control apparatus, shown in FIG. 1, are essentially the same as the elements 60a, 61, 81, 80 and 71 of the conventional power control apparatus of FIG. 7, respectively, and a description thereof will be omitted  
25 for the sake of simplicity of description.

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1           In the power control apparatus of FIG. 1, a  
primary power-supply circuit 11 has an input connected to  
the battery 10. The battery 10 is, for example, a 5-V  
battery. A secondary power-supply circuit 12 has an input  
5 connected to an output of the primary power-supply circuit  
11. The primary power-supply circuit 11 produces a  
primary voltage (for example, 3 V) from the source voltage  
of the battery 10, and supplies the primary voltage  
through a power-supply line 31 to a first driven circuit  
10 21. The secondary power-supply circuit 12 produces a  
secondary voltage (for example, 2 V) from the source  
voltage of the battery 10 or from the primary voltage of  
the primary power-supply circuit 11, and supplies the  
secondary voltage through a power-supply line 32 to a  
15 second driven circuit 22.

The secondary power-supply circuit 12 acts  
as a dependent circuit that operates in dependence on a  
power-supply operation of the primary power-supply circuit  
11. That is, the dependent power-supply circuit 12  
20 operates to supply the secondary voltage to the second  
driven circuit 22 when the first power-supply circuit 11  
is operating.

The first driven circuit 21 and the second  
driven circuit 12 are interconnected by a data line 23. A  
25 data signal output by the first driven circuit 21 is

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1 received by the second driven circuit 22 through the data  
line 23, and the second driven circuit 22 processes the  
received data. A data signal, indicating the processed  
data, output by the second driven circuit 22 is received  
5 by the first driven circuit 21, and the first driven  
circuit 21 further processes the received data.

The first driven circuit 21 and the second  
driven circuit 22 do not necessarily start operation at  
the same time. The first driven circuit 21 may solely  
10 start operation when the second driven circuit 22 stops  
operation. The second driven circuit 22 may not solely  
start operation when the first driven circuit 21 stops  
operation. The second driven circuit 22 starts operation  
only when the first driven circuit 21 is operating.

15 In the power control apparatus of FIG. 1, a  
control circuit 13 which includes a voltage detection unit  
130 and a secondary power control unit 131 is provided.

FIG. 2 shows a configuration of the control  
circuit 13 of the power control apparatus of FIG. 1. FIG.  
20 3 is a time chart for explaining operations of the control  
circuit of FIG. 2. The control circuit 13, including the  
voltage detection unit 130 and the secondary power control  
unit 131, is indicated by a dotted line in FIG. 2.

A description will be given of the  
25 configuration and operations of the control circuit of the

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1 power control apparatus in the present embodiment with  
reference to FIG. 2 and FIG. 3.

As indicated by (a) in FIG. 3, after a  
delay of a given period from a start of operation of the  
5 primary power-supply circuit 11, the primary power-supply  
circuit 11 is set in an operating condition that it can  
supply the primary voltage (for example, 3 V) to the first  
driven circuit 21.

The voltage detection unit 130 includes a  
10 primary voltage detection part 130a and a secondary  
voltage detection part 130b as shown in FIG. 2. As  
indicated by (b) in FIG. 3, the primary voltage detection  
part 130a detects the primary voltage supplied by the  
primary power-supply circuit 11 when the primary power-  
15 supply circuit 11 is set in the operating condition, and  
outputs a high-state signal to the secondary power control  
unit 131 of the control circuit 13.

The secondary power control unit 131  
includes a primary oscillation part 133 as shown in FIG.  
20 2. As indicated by (c) in FIG. 3, the primary oscillation  
part 133 starts oscillation at the same time as the start  
of operation of the primary power-supply circuit 11.  
After a delay of a given period, a clock signal (CK)  
produced by the oscillation of the primary oscillation  
25 part 133 becomes stable.

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1           The secondary power control unit 131  
includes a primary reset generating part 132, and the  
primary reset generating part 132 is constructed by two  
flip-flop circuits which are connected in a manner shown  
5 in FIG. 2. As indicated by (d) in FIG. 3, after a delay  
of a given period since the time the high-state signal is  
output by the primary voltage detection part 130a, the  
primary reset generating part 132 outputs a high-state  
signal (or a primary reset signal) to the first driven  
10 circuit 21.

When the primary reset signal output by the  
primary reset generating part 132 is received, the first  
driven circuit 21 starts operation. At the start of  
operation, the stable clock signal (CK) output by the  
15 primary oscillation part 133 is supplied to the first  
driven circuit 21, and the primary voltage output by the  
primary power-supply circuit 11 is supplied to the first  
driven circuit 21 through the power-supply line 31. The  
primary oscillation part 133 and the primary reset  
20 generating part 132 are driven by the power supplied from  
the primary power-supply circuit 11.

The secondary power control unit 131  
includes a control signal generating part 136 as shown in  
FIG. 2. When transmitting the processed data from the  
25 first driven circuit 21 to the second driven circuit 22

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1 via the data line 23, the first driven circuit 21 sends a  
start command signal to the control signal generating part  
136. The start command signal causes the control signal  
generating part 136 to output a power-supply control  
5 signal (or a high-state signal) to the secondary power-  
supply circuit 12. As the secondary power-supply circuit  
12 starts supplying the secondary voltage to the second  
driven circuit 12 in response to the high-state power-  
supply control signal, the second driven circuit 22  
10 quickly starts operation by the power supplied from the  
secondary power-supply circuit 12.

As indicated by (e) in FIG. 3, when the  
start command signal output by the first driven circuit 21  
is received, the control signal generating part 136  
15 outputs the power-supply control signal (or the high-state  
signal) to each of the secondary power-supply circuit 12  
and the secondary voltage detection part 130b.

On the other hand, when receiving the  
processed data from the second driven circuit 22 at the  
20 first driven circuit 21 via the data line 23, the first  
driven circuit 21 sends an end command signal to the  
control signal generating part 136. The end command  
signal causes the control signal generating part 136 to  
output a low-state power-supply control signal to the  
25 secondary power-supply circuit 12. As the secondary


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1 power-supply circuit 12 stops supplying the secondary  
voltage to the second driven circuit 22 in response to the  
low-state power-supply control signal, the second driven  
circuit 22 quickly terminates the power-supply operation  
5 after the processed data from the second driven circuit 22  
is supplied to the first driven circuit 21.

As indicated by (e) in FIG. 3, when the end  
command signal output by the first driven circuit 21 is  
received, the control signal generating part 136 outputs  
10 the low-state power-supply control signal to each of the  
secondary power-supply circuit 12 and the secondary  
voltage detection part 130b.

In the control circuit 13 of FIG. 2, the  
detection signal output by the primary voltage detection  
part 130a is supplied through a signal line 24 to the  
15 control signal generating part 136. Even when the start  
command signal output by the first driven circuit 21 is  
received, the control signal generating part 136 acts to  
delay the start of operation of the secondary power-supply  
circuit 12 until a high-state detection signal output by  
20 the primary voltage detection part 130a is received. When  
a low-state detection signal output by the primary voltage  
detection part 130a is received, the control signal  
generating part 136 acts to stop the operation of the  
25 secondary power-supply circuit 12.



1           The secondary voltage detection part 130b  
starts operation when the high-state power-supply control  
signal output by the control signal generating part 136 is  
received. Also, the secondary power-supply circuit 12  
5 starts operation when the high-state power-supply control  
signal is received. As indicated by (f) in FIG. 3, after  
a delay of a given period from the start of operation, the  
secondary power-supply circuit 12 is set in an operating  
condition that it can supply the secondary voltage (for  
10 example, 2 V) to the second driven circuit 22.

          The secondary power control unit 131  
includes a secondary reset generating part 134 and a  
secondary oscillation part 135 as shown in FIG. 2. As  
indicated by (g) in FIG. 3, the secondary voltage  
15 detection part 130b detects the secondary voltage supplied  
by the secondary power-supply circuit 12 when the  
secondary power-supply circuit 12 is set in the operating  
condition, and outputs a high-state signal to each of the  
secondary reset generating part 134 and the secondary  
20 oscillation part 135 of the secondary power control unit  
131.

          As indicated by (h) in FIG. 3, the  
secondary oscillation part 135 starts oscillation at the  
same time as the start of operation of the secondary  
25 power-supply circuit 12. After a delay of a given period,

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1 a clock signal (CK) produced by the oscillation of the  
secondary oscillation part 135 becomes stable.

The secondary reset generating part 134 of  
the secondary power control unit 131 is constructed by two  
5 flip-flop circuits which are connected in a manner shown  
in FIG. 2. As indicated by (i) in FIG. 3, after a delay  
of a given period since the time the high-state signal is  
output by the secondary voltage detection part 130b, the  
secondary reset generating part 134 outputs a high-state  
10 signal (or a secondary reset signal) to the second driven  
circuit 22.

When the secondary reset signal output by  
the secondary reset generating part 134 is received, the  
second driven circuit 22 starts operation. At the start  
15 of operation, the stable clock signal (CK) output by the  
secondary oscillation part 135 is supplied to the second  
driven circuit 22, and the secondary voltage output by the  
secondary power-supply circuit 12 is supplied to the  
second driven circuit 22 through the power-supply line 32.  
20 The secondary oscillation part 135 and the secondary reset  
generating part 134 are driven by the power supplied from  
the secondary power-supply circuit 12.

As previously described, in the  
conventional power control apparatus of FIG. 7, even when  
25 the operation of the driven circuit 73 is not needed, the

1 power-supply circuit 63 continuously supplies the lower  
voltage to the driven circuit 73. In such a condition,  
the driven circuit 73 unnecessarily consumes the power  
supplied by the power-supply circuit 63.

5 FIG. 4 shows power-saved periods during an  
operation of the power control apparatus of FIG. 1.

In contrast to the conventional power  
control apparatus of FIG. 7, the above-described  
embodiment of the power control apparatus is effective in  
10 reducing the power consumption of the second driven  
circuit 22. As shown in FIG. 4, the power-supply  
operation of the secondary power-supply circuit 12 is  
suitably controlled such that the supply of the secondary  
voltage to the second driven circuit 22 is enabled by the  
15 high-state power-supply control signal only when it is  
needed, and the supply of the secondary voltage to the  
second driven circuit 22 is disabled by the low-state  
power-supply control signal when it is unneeded.

In order to achieve a speedy power-supply  
20 operation of the first and second driven circuits 21 and  
22, it is necessary that the oscillation of the secondary  
oscillation part 135 becomes stable as quickly as possible  
after the start command signal is output to the control  
signal generating part 136 by the first driven circuit 21.

25 FIG. 5 shows a modification of the

1 secondary oscillation part 135 in the control circuit of  
FIG. 2. A secondary oscillation circuit 135' shown in  
FIG. 5 is provided in order to achieve a speedy power-  
supply operation of the first and second driven circuits  
5 21 and 22. In FIG. 5, the elements which are essentially  
the same as corresponding elements in FIG. 2 are  
designated by the same reference numerals, and a  
description thereof will be omitted.

The secondary oscillation circuit 135' of  
10 FIG. 5 is constructed by a two-input AND gate and a PLL  
(phase-locked loop) circuit which are connected in a  
manner shown in FIG. 5. The AND gate has an input  
connected to an output of the control signal generating  
part 136, and an input connected to an output of the  
15 primary oscillation part 133. The AND gate has an output  
connected to an input of the PLL circuit. The PLL circuit  
has another input connected to an output of the secondary  
voltage detection part 130b. In response to a high-state  
clock signal output by the AND gate, the PLL circuit  
20 quickly produces a stable clock signal with a locked  
frequency, and supplies it to the second driven circuit  
22.

In the secondary oscillation circuit 135'  
of FIG. 5, when the power-supply control signal at the  
25 output of the control signal generating part 136 is held

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1 in a high state, the AND gate passing the clock signal,  
supplied by the primary oscillation part 133, to the PLL  
circuit. When a high-state clock signal output by the AND  
gate is received, the PLL circuit quickly produces a  
5 stable clock signal with the locked frequency, and  
supplies it to the second driven circuit 22. Hence, it is  
possible to achieve a speedy power-supply operation of the  
first and second driven circuits 21 and 22.

Further, in order to more effectively  
10 reduce the power consumption of the driven circuits, it is  
desirable to prevent the flow of a leak current from the  
first driven circuit 21 into the second driven circuit 22  
when the supply of the secondary voltage to the second  
driven circuit 22 is stopped. When there is a difference  
15 in a drive voltage between the first driven circuit 21 and  
the second driven circuit 22, it is necessary to eliminate  
the voltage difference.

FIG. 6A and FIG. 6B show a modification of  
the first and second driven circuits 21 and 22 in the  
20 power control apparatus of FIG. 1.

In FIG. 6A, the first driven circuit 21 has  
inputs at which two-input AND gates 21a are provided, and  
the second driven circuit 22 has inputs at which buffer  
gates 22a are provided. Data signals output by the second  
25 driven circuit 22 are supplied to the AND gates 21a at the

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1 inputs of the first driven circuit 21, and data signals  
output by the first driven circuit 21 are supplied to the  
buffer gates 22a at the inputs of the second driven  
circuit 22. In FIG. 6B, an example of the configuration  
5 of the respective inputs of the first and second driven  
circuits 21 and 22 is shown, in which one of the two-input  
AND gates 21a and one of the buffer gates 22a, shown in  
FIG. 6A, are constructed by MOS transistors and resistors  
which are connected in series as shown in FIG. 6B.

10 The first and second driven circuits 21 and  
22 shown in FIG. 6A and FIG. 6B are provided to prevent  
the flow of a leak current from the first driven circuit  
21 into the second driven circuit 22 when the supply of  
the secondary voltage to the second driven circuit 22 is  
15 stopped.

As shown in FIG. 6A, at the inputs of the  
first driven circuit 21, the two-input AND gates 21a are  
provided. Each AND gate 21a is constructed by a resistor  
and two MOS transistors. The resistor and the two MOS  
20 transistors are connected in series between a primary  
voltage line and a grounded base in a manner shown in FIG.  
6B. Each AND gate 21a has an input (or a gate of one of  
the MOS transistors) connected to a signal line from the  
second driven circuit 22, and has an input (or a gate of  
25 the other MOS transistor) connected to an output (the

1 power-supply control signal) of the control signal  
generating part 136.

When the power-supply control signal at the  
output of the control signal generating part 136 is held  
5 in a high state, the AND gate 21a sets the first driven  
circuit 21 in an operating condition that it can receive a  
data signal supplied by the second driven circuit 22 via  
the signal line. When the data signal that is set in a  
high state by the second driven circuit 22 is received,  
10 the AND gate 21a of the first driven circuit 21 converts  
the received data into a high-state data signal based on  
the primary voltage.

As shown in FIG. 6A, at the inputs of the  
second driven circuit 22, the buffer gates 22a are  
15 provided. Each buffer gate 22a is constructed by a  
resistor and a MOS transistor. The resistor and the MOS  
transistor are connected in series between a secondary  
voltage line and a grounded base in a manner shown in FIG.  
6B. Each buffer gate 22a has an input (or a gate of the  
20 MOS transistor) connected to a signal line from the first  
driven circuit 21, and has an output connected to an  
internal element (not shown) of the second driven circuit  
22. When the data signal that is set in a high state by  
the first driven circuit 21 is received from the signal  
25 line, the buffer gate 22a of the second driven circuit 22



1 converts the received data into a high-state data signal  
based on the secondary voltage.

In the above-described embodiment of the  
power control apparatus in which the first and second  
5 driven circuits 21 and 22 of FIG. 6A and FIG. 6B are  
provided, it is possible to prevent the flow of a leak  
current from the MOS transistor of the first driven  
circuit 21 into the second driven circuit 22 when the  
supply of the secondary voltage to the second driven  
10 circuit 22 is stopped. Hence, it is possible to more  
effectively reduce the power consumption of the first and  
second driven circuits 21 and 22.

Further, the present invention is not  
limited to the above-described embodiments, and variations  
15 and modifications may be made without departing from the  
scope of the present invention.

The present invention is based on Japanese  
priority application No.10-067305, filed on March 17,  
1998, the entire contents of which are hereby incorporated  
20 by reference.